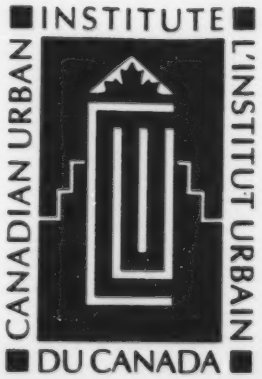
Deep Lake Water Cooling (DLWC)

A district cooling concept for
downtown Toronto based on
cold water drawn from the depths
of Lake Ontario

Report on the DLWC Conference and Charrette held on June 16, 17, and 18, 1991

Prepared
by Canadian Urban Institute

June 19, 1991
Toronto, Ontario



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This is a rough draft produced a few hours after the event. The final version will be available at the end of July together with the final version of the background papers produced for the event.

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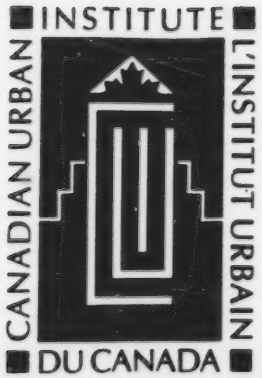

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1 THE PROCESS

Early in 1991, the Deep Lake Water Cooling (DLWC) concept attracted the interest of an ad hoc group of public sector officials involved in buildings technology, in the heating and cooling of buildings, and in the provision of infrastructure in the community. The group comprised representatives of the City of Toronto, Metropolitan Toronto, the Toronto District Heating Corporation, Ontario Hydro, the Ontario Ministry of Housing, the Ontario Ministry of Energy, and Energy Mines and Resources Canada.

This ad hoc group, which named itself the DLWC Investigation Group, was examining whether the perceived environmental and other benefits of the concept were sufficient to warrant a further look at DLWC. The group felt that given a number of factors, including the considerable reduction in the emissions of carbon dioxide and chlorofluorocarbons (CFCs) that could be realized by DLWC, that the timing was right to re-examine its value.

The group's first step was to engage Engineering Interface Ltd. (EIL), the original proponent of the concept, to update the research that EIL had completed in the early 1980s.

The DLWC Investigation Group then commissioned the Canadian Urban Institute, a non-profit organization concerned with issues affecting large urban regions, to :

- undertake consultations with parties interested in or affected by such a concept,
- commission and manage research into issues raised during the consultations,
- develop a conference and charrette* at which the concept would be discussed, and
- report on those events.

The DLWC Investigation Group hoped that through this process it would have more complete evidence with which to consider whether or not DLWC was worth pursuing.

This process was special in a number of ways.

First, before a decision was taken to pursue this new technology, and before a proponent for the concept had emerged, the concept was to be subjected to public scrutiny so that all of the concerns associated with DLWC would be identified. Through this process the varied stakeholders in the concept would also be identified.

Second, the DLWC Investigation Group provided financial support to several interest groups and individuals identified during the consultations as holding specific and significant concerns or insights with respect to the concept. Each was asked to consider its concerns more deeply and prepare a report that would become part of the background material for the conference and charrette. Thus, those who would take issue with the subject would become more knowledgeable about the concept and thus be more effective contributors to the debate around the future of DLWC.

Third, all who were part of the background research process, and others who were interested, were invited to participate in an open conference and charrette on the concept. Interested parties were also provided with an opportunity to contribute to the present report.

Now the conference and charrette are over, the Canadian Urban Institute is to prepare suggestions as to what might happen next. These suggestions will be before the DLWC Investigation Group when it meets on July 25 at 7.30 am in Toronto City Hall.

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* Charrette is a French word meaning cart. The use of the word to denote a round-the-clock study to meet a very tight deadline evolved at the Ecole des Beaux Arts in Paris where deadlines were set by the schedule of the cart that called to collect completed projects. Charrette is now an architectural term referring to a study or project performed within the framework of a tight deadline.

2 OVERVIEW OF DEEP LAKE WATER COOLING AND OF THE BACKGROUND PAPERS PREPARED FOR THE CONFERENCE AND CHARRETTE

This overview is designed to give the flavour of the eleven research reports commissioned for the conference; it is not a comprehensive summary of the reports. The overview is based mostly on the first five items in the list of the eleven reports.

What is Deep Lake Water Cooling?

Deep Lake Water Cooling (DLWC) is a method of cooling buildings in and near downtown Toronto, first proposed by **Engineering Interface Ltd.** in 1981.

DLWC involves exploiting the natural presence of a very large volume of cold water deep in Lake Ontario. The concept includes construction of a long intake tunnel beneath the lake bed to a pumping station on shore. Buildings in the area bounded by Queen's Quay, Bloor Street, Jarvis Street, and Spadina Avenue would be served by a grid of tunnels and branch lines. The pumping station would distribute the cold water to heat exchangers within each building. The warmer water would be returned to the lake via an outfall or outfalls located in the Inner Harbour, the Don River or elsewhere.

This method of providing naturally cold water to downtown buildings would eliminate or decrease the need for the current system of individual, electrically-driven chillers that use coolants containing chlorofluorecarbons (CFCs).

Why is DLWC worth considering?

Office cooling requirements are a result of heat gain from office and other equipment, sunlight through windows, outside air, and occupants. Although advances in equipment design may decrease the heat emitted,

the increasing use of electronic equipment will likely offset the reduction. Hence, without changes in behaviour or expectations, the demand for cooling in downtown Toronto buildings is likely to increase.

There are three kinds of alternative to DLWC:

- One is to do nothing, but this is becoming increasing unsupportable as concerns rise about the emissions from the fossil-fuel combustion used to generate some of the electricity that drives the present chillers, and about the use of CFCs in the chillers.

- The second kind of alternative involves reducing the amount of cooling that is needed either by reducing expectations about the living and working environment or by reducing heat gain within buildings, or by doing both.

- The third kind of alternative involves cooling with other, more benign methods. These might include generating electricity for cooling with fuels other than coal, notably natural gas and even solar energy and wind, using other coolants, and operating absorption chillers that use hot water or steam rather than electricity.

The second and third kinds of alternative are both desirable whether or not DLWC is employed.

Should DLWC be implemented, it could produce these benefits and possible benefits:

- **Lower cost of cooling buildings**

- **Decreased electrical demand:** avoids the cost of new facilities required to handle the summer peak load in downtown Toronto

- **Source of potable water**

- **Reduction in pollution:** decreased reliance on coal-fired and other electrical generating stations, decreased use of CFCs, and decreased use of heavily treated water in cooling towers

- **Local labour:** creation of 10,000 person-years of local labour

- **Source of sanitary landfill**: the tunnel excavate

- **Development of Canadian export technology**

- **Ice melting on Toronto Island ferry routes:** using the warmer water returned to the lake

- **Reduction of fossil fuel imports into Ontario.**

There are also many concerns:

- **Zebra mussels** and other life forms might invade and clog the DLWC system or reduce the efficiency of the heat exchangers

- **Funds might be diverted** from conservation activity

- **Downtown traffic might be disrupted** by installation and maintenance of the DLWC system

- **Toronto Hydro's rates might have to be increased** on account of reduced sales of electricity for cooling buildings

- The reserve of 4•C water in the lake might become exhausted.

The major concerns, however, are not those listed above but concerns about the impact of DLWC on the environment – air, land, and water. Many of these are touched on later in this overview.

Status of DLWC

Engineering Interface Ltd. (EIL) has developed a preliminary design for each of the components of the project. They include: intake, intake tunnel, pump house, north-south supply and return tunnels, valve chambers, branch lines, heat exchangers, customer connections, instrumentation, and outfall.

According to EIL's concept, 4•C water from 80 metres below the lake surface will be drawn through a tunnel to a pump house on the waterfront. The tunnel will be 4.3 metres in diameter, 6.0 kilometres long and 15 metres below the lake bed. Supply and return tunnels, 2.1 to 3.0 metres in diameter, will run through the rock below Yonge Street and University Avenue. Branch lines will be microtunnelled beneath 18 east-west main streets between Spadina Avenue and Jarvis Street.

Naturally cold water will be pumped to buildings connected to the branch lines. The chillers in the buildings will be replaced with heat exchangers that will cool the circulation systems in the buildings. The

replacement is expensive. However, the heat exchangers will occupy much less space than the chillers and will require less maintenance.

The system has been designed for a maximum flow of 38 metres per second. This will satisfy the anticipated demand of 300,000 tons of cooling expected in 2015 (ton of cooling is an engineering term for a rate of cooling that requires close to 1 kilowatt of electricity to produce). In 1991, 200,000 tons of cooling will be required to cool the buildings in the area.

A survey in the King-Wellington area has established that there is a high degree of acceptability of DLWC to potential customers. The cost of customer connection is one of the more difficult expenses to estimate; thus a large safety factory has been incorporated in all cost estimates.

A monthly billing system has been proposed based on the amount and temperature of the water used. EIL suggests that further rate structures be examined.

About 30% of the energy input will be recovered as the water returns to the pumping station site - by means of four turbines driving electric generators.

The outfall will be designed to accept a discharge of 38 cubic metres per second with a harbour entry velocity of 150 millimetres per second. The temperature of the outfall water will be between 10°C and 12.5°C. The discharge system would involve a concrete box culvert. EIL has proposed that the warmer water be discharged into the Inner Harbour. Suggested alternatives include routing a portion of the flow into the Don River.

Environmental Issues

Each of the environmental analyses that has been conducted includes the qualification that it is preliminary; much more extensive studies will be required should the proposal receive further support. Most environmental concerns have been directed toward the potential effects of DLWC on the ecosystem of Lake Ontario. This section describes parts of two of the studies conducted for the conference, by **MacViro Consultants Ltd.** and by **Pollution Probe**.

MacViro addressed five areas of potential environmental concern:

- **Deep Lake Water Intake.** Considerations include the depletion of 4°C water and the possibility of fish entrapment or entrainment. These concerns are considered to be unfounded or possible to mitigate through design measures. Additional investigations on deep water benthic biota (lake bottom plants and animals) are recommended.

- **Cooling Water Discharge.** Three outfall scenarios were appraised, all involving the Inner Harbour. Using computer modelling, MacViro determined that the scheme causing the least impact on Inner Harbour temperature and water quality would have two discharge points into the Harbour (at Jarvis Street and Spadina Avenue) with a portion of the outfall (10 cubic metres per second) diverted to the Don River at Bloor Street. The impact of temperature changes on aquatic life requires further investigation. The oxygen content of the outfall water would need to be enhanced If flow is diverted to the Don River, water levels will need to be monitored and flooding prevented by a control gate during high water levels. Erosion, sedimentation, and re-suspension of deposits are either not a concern, according to MacViro, or may be suppressed at the outfall sites. Effects on ice cover are considered negligible or positive.

- **Displacement of Emissions.** Two potential environmental benefits of the DLWC proposal are: (1) the reduction of emissions associated with the generation of electricity; and (2) a decreased reliance on the CFCs used as refrigerants in chillers. Ontario Hydro's peak energy demand periods coincide with cooling load maximums. Generating plants such as Lakeview that rely on fossil fuels are used by Ontario Hydro as peaking plants. (Ontario Hydro has cautioned that a direct link between fossil-fuel use and peak-demand periods is not possible, and that by the time DLWC would be implemented coal-fired facilities may no longer be in use.) The reduction in carbon dioxide emissions resulting from a DLWC system is estimated at 146,000 tonnes per year. (The total CO_2 emission from coal-fired generating plants in Ontario is 28 million tonnes per year.) Methane and nitrous oxide are more potent greenhouse gases; emissions of them would also be reduced. Use of CFCs, which contribute both to stratospheric ozone destruction and to the enhanced greenhouse effect, could be virtually eliminated in the area served by DLWC.

- **Air Quality.** Both high air temperatures and high humidities contribute to the trapping of contaminants close to the ground – a process known technically as *fumigation*. Currently, heat is transferred from downtown buildings to the atmosphere in moisture.

With DLWC, there is potential for a decrease in ambient air temperature and a decrease in humidity. This could result in a small reduction in frequency and duration of periods of fumigation.

- **Disposal of Excavated Materials.** It is unlikely that the chemistry of the shale and soil resulting from tunnelling processes will be of concern. Cost effectiveness may argue for the use of this material as fill.

Other factors surveyed in less depth by MacViro were the issues of heat rejection into Lake Ontario, heat rejection into the atmosphere, and water surge possibilities. Negative impacts due to heat rejection into the lake or the atmosphere are not anticipated. Water surge is a common problem in potable water systems and may be avoided with proper design.

Pollution Probe conducted a preliminary examination of the potential ecological impacts on nearshore ecosystems, with some attention to the possible effect of locating the outfall offshore. The Pollution Probe researchers recommend that neither the Inner Harbour nor the Don River be considered as an outfall location. Changes in flow volume and temperature, increased erosion, increased sedimentation, and resuspension of contaminated sediment may cause negative impacts on plant and fish species. Offshore outfall is considered the least environmentally disturbing option; but it requires much further study.

The report by Pollution Probe notes that the flushing effect of an increased volume of water flowing through the harbour or the river could improve the quality of the water, but pollutants would be moved into the open lake. Currents outside the inner harbour flow to the west; as a result, contamination of the western beaches or spawning grounds in the open lake could result. Dilution by the outfall water of the contaminant loadings in the Inner Harbour or the Don River could result in a false sense of security about quality of Lake Ontario water.

Adverse ecological impacts could also be caused by the proposed intake system. Fish entrapment in the tunnel, entrainment of plankton and larvae, and impingement of fish against the intake screen are possible effects that need to be prevented.

Suggestions to flush the sewer system with the used cooling water, to create decorative waterfalls in the downtown core, and to recharge aquifers were all rejected.

Pollution Probe also cautions about *ecosystem surprises*: changes to a local ecosystem may result in unanticipated impacts on the larger ecosystem, namely the Great Lakes.

Further concerns raised by Pollution Probe include:

- The importance of adequately addressing energy efficiency prior to implementing DLWC, possibly through full-cost pricing of electricity.

- The prospect of expansion of DLWC here and to other places, and a consequent cumulative detrimental effect on the Great Lakes ecosystem.

- The need to avoid chemical treatment of the DLWC water.

Is DWLC a Megaproject?

The question was raised during the initial consultation process as to whether implementation of DLWC would be a megaproject. **Energy Probe** concluded although DLWC could be characterized as a megaproject according to some of its attributes – particularly in the areas of economic, social, and management – and to some extent in the environmental area, it would be very different from a megaproject in other ways. In Energy Probe's words ``it is geographically much smaller, much less expensive, [it requires a] much shorter lead-time, [is] much more thermodynamically elegant, and apparently much less disruptive environmentally than virtually any of the energy megaprojects that have become famous in the last decade or two". In comparison to the *status quo*, which is in a state of flux, DLWC may indeed be a more desirable alternative, the *status quo* cooling system whose energy is provided by ``classic megaprojects". This does not mean, however, unqualified support bt Energy Probe for the DLWC concept.

Financing and Managing DLWC

The length of the environmental approval process will be the determining factor in construction scheduling and therefore cost. The proposed schedule allows three years for environmental assessment. However, cost estimates are based on a pessimistic schedule that involves a 1997-1998 construction start.

The estimate of total cost of the construction of DLWC includes provision for, among other items, consulting fees, construction, contingency, heat exchangers, customer connection, customer engineering, taxes and interim financing. Some of these items may be borne by either the customer or the proponent.

Before accounting for a subsidy by Ontario Hydro, the cost of DLWC is estimated at $611,000,000. The net cost after incorporating the Ontario Hydro thermal storage incentive of $400 per kilowatt is $475,751,800.

The first issues to resolve involving the economics of DLWC are whether it can be financially self-sustaining and whether it should be. If environmental or economic considerations point to a subsidy, two methods are suggested by the **Canadian Institute for Environmental Law and Policy** (CIELAP). Both are consistent with the polluter pays principle. One is to levy all actual and potential customers. The other is charge all the customers of Toronto Hydro or Ontario Hydro – on the grounds that DLWC will reduce pollution from electricity generation.

The question of ownership and management of DLWC was also addressed by the CIELAP. Options include:

- A municipal corporation
- Toronto Hydro
- A specially established provincial crown corporation
- Ontario Hydro
- A business corporation.

In each case, the proponent will be accepting the risk of a deficit, as well as the potential benefits. The manner of ownership will determine the extent of taxes paid to various levels of government.

Other issues related to proponency include the costs of borrowing, which would be high but less expensive for a provincial agency. Consequently, `profit' potential is higher for a provincial crown corporation than for a municipal corporation. There may be public resistance to an already large and powerful corporation such as Ontario Hydro becoming larger and more powerful. A private venture may be most susceptible to demands for expansion of the system should DLWC be a success. Expansion may not be in the public interest if other options could meet the demand for cooling at a lower environmental cost. A business

corporation may be the most adept at exercising discipline with respect to control of costs.

Tenants and building owners would prefer an ownership scheme that would minimize their costs. However, it is not possible to draw clear relationships between DLWC rates and the ownership options.

List of reports produced for the Conference

Engineering Interface, Position Paper for a Lakewater Cooling System for Downtown Toronto

MacViro Consultants, Environmental Studies Report for the Deep Lake Water Cooling Investigation Group

Pollution Probe, An Examination of the Ecological Impacts of the Deep Lake Water Cooling System on Nearshore Ecosystems

Canadian Institute for Environmental Law and Policy, Deep Lake Water Cooling: Cost Recovery and Ownership Issues

Energy Probe, Is Deep Lake Water Cooling a ``Megaproject''?

Member, DLWC Investigation Group, Deep Lake Water Cooling - Financial and Organizational Considerations

Allen Associates, Deep Lake Water Cooling Alternatives

Metropolitan Toronto Works Department, Deep Lake Water Cooling as a Supplemental Municipal Water Supply

City of Toronto Department of Public Works and the Environment, Deep Lake Water Cooling: Construction Impact on Downtown Traffic

City of Toronto Department of Public Works and the Environment, *Central Air Conditioning - Noise Ramifications*

City of Toronto Department of Public Health, Environmental and Health Impacts Associated with Cooling Towers

3 REPORT ON THE CONFERENCE

Sunday Evening, June 16, 1991 Concept Overview

Introduction: **Jack Layton** opened the Conference by saying he had always thought air conditioning was a great invention. His father's firm was in the field and he was bred on its technological marvels. He had also in his chemistry studies assumed CO_2 was harmless.

Since 1986 or 1987 he has come to realize that air conditioning has harmful side effects and that CO_2 emissions are one of our most dangerous problems.

This last week there has been a global warming conference and one of the inaugural meetings of the International Council for Local Environmental Initiatives (ICLEI), the only UN-sponsored organization in Toronto. There are several experts in the room who know the problems of CO_2 and air conditioning in other urban areas.

Layton said he had not earlier realized the linkage between air conditioning, CO_2, CFCs and global warming. His recent reading has convinced him that air conditioning - "taking heat from inside a room and pushing it outside" - is a dangerous action. The CO_2 that is emitted is among the greatest causes of global warming - it cools us now and heats us later.

We have a challenge. When he first heard of deep lake water cooling, then lnown as Freecool, it was tied to the incineration of waste to generate energy. He had been against using waste to generate electricity, so he had been against both concepts. His appointment to the Toronto District Heating Corporation changed his approach. He has been exposed to the views of Richard Gilbert — who has many good ideas he has researched — at least half of which make great sense. He

praised the CUI, which Gilbert is now president of, for the excellent job it did in organizing the conference.

For the past five or six months, he has been working hard on trying to show people the costs and benefits of the concept. He praised the background studies as being of very high quality, which have dealt with the toughest of questions fairly, without prejudgment.

The organizing group has adopted a strategy of sitting down the proponents of deep lake water cooling with those who are most likely to have concerns with the idea. The aim is to influence the development of the project. The reports have been well worth the money.

He said the term "Freecool" has been changed because nothing is free. Deep lake water cooling (DLWC) seems to be a more appropriate terminology.

One of the key questions is whether this is a "green" technology of a sustaining nature. He is concerned to get this issue discussed fully.

Layton then briefly described the Deep Lake Water Cooling proposal. He said that an ad hoc group of representatives of public agencies representing all four levels of government had been formed five months previously to investigate the concept further. This group, the DLWC Investigation Group, which he co-chaired, commissioned research work on the proposal and asked the Canadian Urban Institute to organize this conference. Layton then outlined the agenda of the conference and the "charrette", proposed for June 18, to discuss more specifically the pros and cons of proceeding further with the proposal. He then briefly outlined the main points of the research work that had been commissioned as background to the conference.

Layton then introduced the leaders for the following day's sessions.

Summary Statements by Discussion Leaders:

Greg Allen said he was an engineer concerned with the state of the planet. His task was (since he had worked for Campeau on its waterfront projects and had investigated Freecool 10 years ago) to look at the need for reducing CO_2 emissions in Toronto. This was the historic method of cooling - the Indians cooled themselves in the lake. He was also asked to look at potential alternative methods of reducing CO_2 emissions and meeting demands for cooling. He has some concerns about large projects but believes the status quo is not sustainable.

Henry Regier of the University of Toronto said he has worked on Toronto water since 1954. He has also been very involved in Great

Lakes issues and comparisons with other bodies of water like the Baltic Sea. It used to be that big engineering projects were "godsends". Now the proponents of such projects must show they have thought of environmental and ecological health. He was concerned that the initial project had not fully considered environmental impacts, while human health impacts had hardly been looked at.

The Pollution Probe and MacViro studies have emphasized possible harmful impacts. If pollutants are only dispersed, this is no solution. He is concerned that the potential heating of the lake has not been properly dealt with. Even a small heating effect could be harmful. The documentation prepared for the conference does not deal with possible beneficial uses of the waste water:

- it should not be used to dilute pollutants
- it should be kept separate to return other water courses to a more natural state
- cold, clear water should be used for a high ecological purpose

There should be some creative ecologists looking at it.

Richard Gilbert spoke for **Danny Harvey** of the University of Toronto. Gilbert paid special tribute to Bob Tamblyn, the originator of the project, to Jack Layton, for getting the present process started, and to Gillian Mason of the Canadian Urban Institute who has been the most important person in the organization of the conference ans associated processes.

Gilbert said Danny Harvey is one of Canada's most distinguished atmospheric scientists, a world leader in the global warming field. He said that unlike the impact on the water, where the jury is out - the impact on the air is at least 95% positive. DLWC will virtually eliminate CFCs. In 1985 and 1988, when DLWC was raised before, there was no serious concern about CFCs or global warming. In 1991, the CFC and global warming imperatives are driving support for the project. There are also lesser, but largely beneficial, impacts on the air.

There are some land concerns on account of the amount of tunnel excavate to be handled. It could be used to cover the Ataritiri land or to create new land in the lake for housing. There will also be problems of construction - noise and disruption. The City's Public Works Commissioner only knows 75% of what the "spaghetti" under the city consists of.

Norm Rubin of Energy Probe said his session's task would be to study whether the project is economically viable, who should be in charge, how the costs and benefits should be shared, and similar "make or break" issues. There will have to be discussion of the criteria as to whether it should be a "go" or not. He said it would be easier if a syndicate or consortium were prepared to go ahead with the project. Nevertheless, all aspects should be explored. He said that he, like Jack Layton, is very impressed that the additional heat that might go into the air would be less than the heating of the air produced by the generation of electricity for the current air conditioning units.

Jack Layton said that notes on the proceedings would be distributed by the CUI.

Discussion: Layton then asked for questions or comments from the floor on the presentations or on concerns that may not have been addressed in the background studies.

Bob Tamblyn thanked Henry Regier for his comments. He assured him he had talked to various government experts on the impact on the fishery.

Burkhart Mausberg of Pollution Probe asked why the organizers had not looked at the potential impact if other cities on the Great Lakes did the same ting.

Jack Layton admitted this was a serious question that must be looked at. He said that Xerox and Kodak in Rochester were thinking about a similar project. **Michael Wiggin** of Energy Mines and Resources said it is important to look at the impact of the Toronto project. He explained the annual renewal of the cold water resource because of our climate. He said that there were some annual variations in the level and amount of 4^{o}C water.

Richard Gilbert asked what margin of safety with respect to depletion Pollution Probe thought tolerable, assuming that cold water in Lake Ontario is a renewable resource.

Mausberg said he couldn't answer the question and didn't want to imply that Pollution Probe supported the project.

Richard Gilbert then asked if the question was appropriate and whether there could be a tolerable limit.

Mausberg said this would raise a tough question about how you would tell other cities in 10 to 20 years that the tolerable limit had been reached. The sharing of the renewable resource would raise very tough questions.

Franz Hartmann of the Toronto Environmental Alliance asked what percentage of the CFC emissions came from air conditioning for office buildings.

Bob Tamblyn said that 66% of electricity use in Toronto was for office buildings.

He said that he had been told by government that a level of concern for water quality and depletion of the cold water reservoir would be reached if projects 50 times the size of Freecool were proposed.

Jack Layton said the current uses of electricity would be explored in the sessions.

Henry Regier said that you can't say cold water is totally renewable. The system turns over twice a year.

A representative of the Public Advisory Committee said that the MacViro study is suspect because you can't make definitive answers over time. He added that the use of landfill to cover Ataritiri or develop landfill sites in the lake would be opposed.

Michael Wiggin said that cold water drops to the bottom and mixes with water of other temperatures. Every winter it develops a common 4^{o} temperature near the bottom.

Norm Rubin said that on the question of expansion, current electrical generation stations are the key emitters of hot water into the lake now. He saw the possibility of using the cool waste water from DLWC for electricity generating stations to increase their efficiency.

Wiggin replied that this would not help to produce more power. He said EMR and Ontario Hydro were looking at other forms of cooling electricity generating stations.

Jack Layton then asked all the participants to introduce themselves and their interests in the project.

Points made during the introductions included:

- the potential export potential of the technology
- the impact of zebra mussels
- the cost of not doing it
- what about other energy concerns in Toronto - where does this fit in the priorities?
- how could district heating and cooling be combined?
- will the project really be an example of sustainable development?
- how do you get four levels of government, NG0s, academics and private-sector representatives together?

Jack Layton concluded the evening by thanking everyone for coming. He asked people to register for the charrette on Tuesday if they wanted.

Monday, June 17, 1991: Morning Sessions

Introduction: **Richard Gilbert** opened the session by reviewing the history of the proposal and the present process.

Gilbert said the speakers would introduce themselves although he paid particular tribute to Bob Tamblyn, the originator of the concept.

Session A - Need For Cooling And Alternatives **Greg Allen** began. He said he had been in the energy conservation business for twenty years. He said his research taskfor this event had been to explore other methods than DLWC of cooling the downtown and dealing with the CFC issue.

He said there is a real problem with cooling towers, which would be eliminated.

He said we have lived with air conditioning for a generation. The design of cooling equipment for downtown buildings has been a big engineering concern. It has given rise to a number of problems:

- interior air quality

- loads on indoor electricity

- external air quality

- emission of CFCs

In looking at DLWC, there is a danger that some of the other issues of air conditioning could be moved down the priority list. There are issues of demand reduction that must still be tackled:

- ventilation loads have been climbing rapidly

- sources of pollution must be tackled

- dilution of pollutants is no solution

He listed other considerations:

- Sometimes air being emitted from office buildings is of a higher quality than air inside.

- There is a big opportunity to reduce lighting load in downtown buildings. There have been great strides in window technology recently. New windows can reduce indoor heat substantially.

- Fans alone are a significant component of cooling demand so reduction of indoor heat can have compound beneficial effects.

- There is a real problem that our financial context requires a payback of capital investment in two or three years - government should try to lengthen this.

- There are new technologies developing in solar heating. We can use ice rather than cold water as a cooling medium. If cooling can be delivered, and demand is reduced, we can reduce the capital cost of buildings.

Bob Tamblyn of Engineering Interface said he has been in the business of energy management for 18 years. He said he has generally agreed with Allen except on the potential degree of reducing energy demand in buildings.

He went through a series of reductions in energy demand in different categories of buildings. He said the reduction of load has been much less than what is technologically feasible. The biggest reduction will be

in lighting demand. Ontario Hydro is now working on demand reduction.

He said it is much easier to talk about reduction of energy demand in new buildings than in existing buildings. He said there is a lot of indifference or opposition among engineers and building owners. He provided examples of the slowness of acceptance of low energy lighting even though savings arrived just a few months after installation.

He showed several charts to illustrate his points. One was to demonstrate disincentives to energy conservation in buildings. He showed how building owners hesitate to take risks with energy conservation measures if it results in tenant unhappiness. He said energy conservation suffered from ``snake oil'' salesmen of doubtful new developments. Developers have been even less willing to take risks than building owners.

Possibilities for energy reduction are greatest for lighting. Cooling will probably not change much because of enormous heating increases in buildings as computers and laser printers multiply. Much new office equipment is now left on at night. People are afraid to switch off computers for fear of losing data. The load will increase as office automation becomes more complex and sophisticated.

Ventilation is still a big issue as air quality concerns mount. New standards have been set for CO_2 levels, which have moved from 10,000 ppm to 600 ppm. At the same time, CO_2 levels have been rising in the outside air. This has given rise to a huge increase in energy consumption for ventilation.

There are barriers to window improvement. People don't like smaller or reflective windows.

He showed charts to illustrate opportunities for reducing lighting requirements - up to a 70-80% reduction.

John Smale of Dupont Canada was preceded by some introductory remarks by Michael Wiggin, Energy, Mines and Resources, Canada.

Wiggin said CFC had been touted a ``wonder'' chemical which has been used for phones, spray cans and air conditioning. Only recently the harmful side effects of CFCs have been realized. The worst side effect is ozone depletion where there is now a scientific consensus. Canada took the lead in the Montreal declaration for reduction of CFC use.

Many manufacturers are moving to less harmful refrigeration means using HCFCs. The concern is that demand has to be reduced also. There has been great concern in the manufacturing industry as scare stories have proliferated. There is a lot of work going on to develop alternatives to CFC-based cooling systems. They will all result in changes to equipment and continued electricity demand. Many of the alternatives may be even less efficient so the electricity demand to drive chillers will not decrease. These are arguments for district cooling systems and DLWC.

John Smale is the expert technician for Dupont Canada who has often been advisor to governments on CFC issues.

He said he would give a brief summary of new adaptations in refrigeration and in the air conditioning industry. He said air conditioning had made great changes in building techniques like sharp reductions in ceiling heights.

He said there had been a big debate over the causes of ozone depletion. There is now consensus that it results from chlorine in the atmosphere caused largely by CFC emissions.

There is now scientific consensus to speed up the Montreal declaration targets. Canada has accepted a zero target for CFC emissions by 1997. This poses a huge challenge to manufacturers and building owners. Building owners must develop an inventory now of their CFC producers. Refrigeration systems must be replaced or upgraded to meet new standards. Air conditioning systems must be converted to have the lowest possible greenhouse effect.

He went though the types of replacement systems that will be required for refrigeration and air conditioning systems and the large compatibility and adjustment issues that will arise. He said there will have to be training programs for building maintenance staff.

He said new systems will be based on HCFCs (with no chlorine) or HCFCs (with low amount of chlorine). There will have to be continued surveillance of HCFC's depending on chlorine levels in the atmosphere. Seventy-five percent of emissions come from service work rather than installation. It is therefore important that servicing methods be changed to recover and recycle potential emissions. He said such servicing changes could dramatically reduce chlorine emission levels.

Discussion: Richard Gilbert mentioned the CFC emissions caused by automobile air conditioning and steps being taken in Southern California and international organizations.

Jack Gibbons asked if DLWC was the only system available for downtown Toronto with no ozone depletion impact. John Smale said that there are alternatives. Greg Allen said there had to be because many cities would have no access to DLWC. Bob Tamblyn said that ammonia could be used as an alternative coolant.

Burkhard Mausberg said that the priority must be to reduce demand. He could not support DLWC until there were massive efforts to reduce demand. He said that the real cost of electricity was not being charged.. Full cost pricing must be established. He said he was concerned about the cumulative impact of several DLWC systems around the Great Lakes. He said Freecool really would amount to a gigantic dilution of pollutants.

He said Pollution Probe would like to see a requirement that buildings reduce their cooling by 75% before they could move to DLWC. Otherwise he said DLWC would be a technological bandaid rather than going to the source.

Bob Tamblyn said there would be a huge economic problem in following this route - the payoffs may not be there for building owners.

Franz Hartmann of the Toronto Environmental Alliance said that he was convinced that CFC use could be reduced by existing technical advances. He said it is true that it comes down to who pays. With the DLWC approach, the people will pay because demand reduction won't be tackled. The alternative is a massive improvement to energy efficiency. He said we can't use ``bottom line'' approaches to stave off massive energy use reduction methods.

Session B - Environment-Water Concerns This session was introduced by Henry Regier, head of Environmental Studies of the University of Toronto.

He said that among the issues to be addressed were:

- the degree to which cool water was a renewable resource
- the degree to which the project was in the context of sustainable development
- the health and social impact

He said all the panellists agree with him that the environmental impact has only begun to be addressed.

Adel Ashamalla of MacViro Consultants set out a series of slides on the environmental impact of the returning water on the lake in terms of temperature and water quality. Other issues include the impact on currents, potential flooding, ice cover and density.

He said his study covered 3 possible discharge locations:

a. the harbour at Jarvis Street

b. the harbour at Spadina Avenue

c. partly into Don River

His method covered two models - a two-dimensional one using 17 or 18 cases - done by Gore and Storrie, and a second model developed by the City of Toronto.

Different simulations were done for wet and dry weather and for different seasons. Extremes in climatic conditions were also simulated.

He showed a series of slides with the results of the studies. They showed, among other things, changes in water temperature in the harbour. He showed a summer impact of up to 1°C all the way to Toronto Island and up to 2°C at the York Street slip about 120 metres from the emission point.

He said the winter impact would be very localized at the emission points with no discharge into the Don in winter.

The analysis of water quality was on the basis of fecal coliform levels. He said there would not be heavy impacts but there would be some improvement because of clean water discharges.

With regard to the Don River, he said summer temperatures could be increased by up to 3°C but with a significant improvement in the water quality. He said there was an assumption that oxygen levels would have to be maintained by aereation before emission.

Burkhard Mausberg of Pollution Probe thanked the organizers for inviting his organization at the onset of the project. He also thanked his co-author.

He said his study was to try to estimate the overall environmental impact on the water. He said the study had many limitations because they were not given optional intakes and emission points nor a range of water temperatures at different times and seasons.

He said his concern was the impact on an overall ecosystem approach. He said there would be ecological "surprises" that could not be predicted.

He said that currently the Don and the harbour were in serious environmental condition. He said the DLWC discharges would replace harbour water about 4½ times a year and would therefore dilute current pollutants and "liberate" contaminated sediments. He said that Toronto Harbour's contaminated segments were the second worst to Hamilton's on the Canadian side of the Great Lakes.

He said he was concerned that Ministry of Natural Resources efforts to clean up beaches would be harmed by the proposal. He said temperature changes would have unpredictable impacts (his study did not have benefit of MacViro computer models).

He cautioned against using sewers for water discharge. He said one could look at other consumptive uses of the discharged water than putting it back in the harbour. He also said there would be an impact of the construction of the water intakes.

Gerald Mackie said he was mostly concerned with zebra mussels. He showed by slide examples of zebra mussel infestation on water intakes. He went through the stages of development of zebra mussels and how the mussels attach themselves to pipes. He showed charts of seasonal peaking of zebra mussels over the 1988-90 period. He showed higher peaks in Lake Erie than Lake Ontario, but considerable seasonal fluctuations.

He said that distribution was the widest in Lake St.Clair and Lake Erie but now covered most of Lake Ontario and some of the waters flowing into it like the Rideau Canal.

He said most of the mussels were at the 3 to 7 metre level but that they went down to at least 15 metres. He said there were more zebra mussels in the Great Lakes than anything reported in Europe.

He showed slides on the reproduction of mussels at different temperatures. He said that they reproduced in water as cold as 8°. He

said therefore that zebra mussels could not reproduce at 80 metres nor at 4°.

Discussion: Henry Regier said he had been responsible for some of the concerns that had come out in the Pollution Probe report - especially on alternative possibilities for using water emissions. He said there was a possibility for using clean waste water to regenerate water aquifers, for fountains or to discharge some of the water south of the Toronto Islands to create a more natural shoreline. He reiterated the bad impact of merely diluting pollutants. He thought it might be possible to use clearer discharge water to provide comparisons between current water quality and what it used to be.

Ila Bossons said there appeared to be large differences in volume of outflow.

Mausberg said this was because of seasonal variations. He also said there was phosphorus in the deep lake water.

A questioner asked what the impact would be on the deep water from which the water would come.

Ashamalla said this had been looked at by MacViro. A MacViro consultant said it had looked at shallower intakes used by Hydro. Otherwise he said the impact on the deep water would be very localized around the water intake. The key impact would be on fish habitat. He said there would be very little impact on currents or on stratification of water.

Jack Vallantyne made 5 points:

- This is a good proposal and would have been great 100 years ago. He says there has been no study of the impact of a number of potential DLWC projects in other parts of the Great Lakes.
- While he accepts the arguments about CFC reductions, he says this is trivial compared to the wider environmental issues. He said most people think of Toronto as already cool compared to most of the world.
- He says while this might be an ecosystem approach, it does not cover the wider ecosystem.
- He said he would be distressed if this were to be subsidized by government.

- He said the real problem was one of human behaviour.

Farrell Boyce of the Water Quality Research Institute said he was concerned that the harbour water structure would be affected. He asked about the sophistication of the MacViro model.

Ashamalla said his study was a preliminary one and it set out some of the requirements for future, more detailed studies.

Boyce said he did not see that there would be much of a deep water phosphorus problem. Mausberg said there would be an impact, particularly in the Don River.

Boyce said the Canada Centre for Inland Waters had provided data for intake pipes. He said there is a huge reservoir of 4° water in the Great Lakes which could be affected by 50 DLWC projects but not by one. He said Lake Superior had much less regeneration. He encouraged the project to look at longer-term impacts in light of overall global warming trends.

Bob Tamblyn showed some slides on the amount of heat that would go into the lake. He said the maximum amount of heat that would go into the lake would be equivalent to 9 seconds of sunshine. He said he had thought that by taking clean water out of the lake and returning clean water to it there would be no big problem. Having seen the concerns about the impact on the harbour, he asked if the discharge water could be used to clean the western beaches.

Ashamalla said this had been looked at but that there were more cost-efficient ways of cleaning up the beaches.

Henry Regier said that sometimes small changes in water temperature can produce huge impacts - so possible impacts cannot be discounted because of the smallness of the impact.

Richard Gilbert asked how one could determine whether a system is sustainable. The answers could be different if this is considered to be a renewable resource or not.

Henry Regier said there is no free lunch - there is no such thing as a completely renewable resource. The question then becomes what level of change can be tolerated.

Gilbert then asked if DLWC is in the tolerable range.

Regier responded that this is a political - not a technical - question. If depletion of cold water is to be rejected, that is a political question.

Farrell Boyce said that it might be possible to say that after 50 years the cold water might be depleted. He then asked Dr. Mackie if zebra mussels could survive at the 80 metre level - and whether he could be categorical about it.

Mackie said that even at 8° there was very little potential for a problem so he had no reason to expect they would survive at 4°.

Norm Rubin said that some issues like using emission water to clean beaches were political, human value, issues. Whether these should be dealt with depends on our definition of the problem. He said, for example, that the chief Ontario Hydro designer of Darlington had proposed using warm water outflow to warm up beaches and extend the swimming season. He said that the current trend of opinion is much more against this kind of change to the ecosystem.

With regard to the potential of many other DLWC systems coming into effect, he said this raised problems similar to a neighbour growing a tree that shadows one's garden. He said such issues could create positive dynamics because it will force different agencies to talk. He asked Gerald Mackie if zebra mussels could expand to block outflow pipes as well as inflow.

Mackie said he did not foresee any mussels on the intake pipe - problems would be elsewhere in the system. Mausberg said outtake pipes would be copper plated which would not attract mussels.

Henry Regier addressed himself to Richard Gilbert's question about renewability of the resource. He used the example of changing water temperature to restore lake trout to the lake. He said that could be a technical question. He added that the Great Lakes Water Quality Agreement touches quality standards but not temperatures.

Richard Gilbert then posed the parallel that DLWC would be like putting a solar cell on your roof that permitted you to use more energy consumer goods whose production involved a lot of consumption of non-renewable energy. He said therefore that if DLWC is essentially renewable, it is like solar energy. If it is not renewable, it would be like using fossil fuels. He said he would be happy to support it only if it were renewable.

Henry Regier said you might term it renewable if there was no serious dissent in terms of the environmental impacts.

Farrell Boyce said the water is renewable. The heat may be, but it depends on how many users.

Burkhard Mausberg said the parallel with solar is not exact. He said the difference is that you have to pump the deep water in. He also said that DLWC may not be "equitable" because it only deals with downtown Toronto.

Franz Hartmann of the Toronto Environmental Alliance said we have to review the proposal in the context of efforts to change people's habits. His concern is that going ahead with DLWC will reduce pressure on other methods of energy efficiency.

An intervenor said the grand picture may result in a net cooling of the lake.

Michael Wiggin said the discussion was ignoring the bigger picture. He reminded people that there would be much less heat going into the atmosphere and much, much less CO_2s into the air. He did not agree that DLWC would hinder other means of improving energy efficiency.

John Barr of Metro Planning said that one should look at all impacts on life forms as a result of intakes, emissions and water temperature change.

Henry Regier said the studies had not really addressed these issues. He said there could be impacts on aquatic plants.

Bob Tamblyn said the amount of energy used in cooling office buildings is only 2/19ths of the amount of energy used in office buildings.

Marcus Ginder of Pollution Probe said renewability is an elusive concept. The management of a renewable resource is important and makes it renewable or not. Henry Regier agreed that it was renewable ``use" that is important rather than renewable ``resource".

Norm Rubin said that the only resources people have wiped out are ``renewable" ones. We have never wiped out a mineral, but we have wiped out forests. He says there are some resources that are more affected by use than others. He says he does not see a big problem with the renewability of deep water in Lake Ontario.

Henry Regier said if we deal with both quantity and quality, we cannot exclude the unexpected.

Lunch Session: The Municipal Context

Aubrey Leblanc introduced Joan King, chair of the Metro Works Committee, and said that Tony O'Donohue, of Toronto City Council, had been detained at a council meeting.

Joan King said that she had distributed summaries of Metro's strategic plan - into the context of which she wanted to place the DLWC project.

She said Metro has spent nine months tackling a strategic vision. She referred specifically to the emphasis on the environment as a top priority. Every project will have to be judged by its environmental impact. Metro will try to promote activities that will be environmentally sound.

She can relate DLWC to Metro's plan. She says Metro and the City have been concerned with CO_2 reduction. There will be another conference organized by the International Council for Local Environmental Initiatives (ICLEI) in the fall on specific means of reducing urban CO_2 and improving ozone depletion. The goals statement talks about the benefits of maximizing public and private investment - into which district heating and cooling systems would fit.

She said Metro has been adopting targets for the emission of pollutants. She said DLWC, if implemented, has the potential of leading towards the reaching of these targets. She said the upsides and the downsides have to be explored.

She said she was heartened by the session in the morning by the degree to which the proposal had made people think. She was glad by the diversity of people represented at the conference because politicians need input from many different sectors of society.

She said that in Metro attention had to be turned to changing societal values. Metro is now dedicated to sustainable urban development.

She said she is looking forward to advice from the participants in the conference.

Aubrey Leblanc, in thanking Joan King, said the dialogue on DLWC has now begun.

Monday June 17, 1991: Afternoon Sessions

Session C - Environment-Air And Land Concerns

Danny Harvey of the U of T introduced this session.

The first speaker was Anthony Ciccone of Concord Environmental Corp.

He showed a series of slides showing the land-air relationship in the Toronto area. He showed the typical impact of winds carrying pollutants through the thermal boundary layer. He said the difference in the temperatures between the air and the water determines the height of the thermal boundary layer.

He looked at the impact of DLWC on local air quality, assuming it would increase the temperature of the water and decrease the temperature of the land. He said the interaction of the difference in the temperatures drives the impact. This model tested winds between April 15 and October 15 and differences of greater than 3° between lake and water temperature.

If land temperature is cooler by 1° there will be a decrease of "lake breeze" conditions which causes fumigeneration. If water temperature goes up, the adverse impacts are even less. The less the difference between land and water temperatures are, the less pollution is carried.

Ciccone added that ground level ozone is also decreased by a decrease in land temperature which should have beneficial health effects.

The second speaker was **Bob Honsberger** of MacViro Consultants. He looked at the difference between electrical displacement of the current system and the DLWC system. At present the electricity use for chillers coincides with peaks of hydro generation using fossil fuels in the Toronto area - 20% of the CO_2 emission in the Toronto downtown.

MacViro's studies are not exact because they have not had time to get full Ontario Hydro calculations.

The introduction of DLWC will reduce air temperature slightly but may add slightly to humidity, through evaporation.

His study also looked at the impact of the excavations and at several alternative uses for the fill. He said the Crombie Commission is now looking at a longer-term policy for lake landfill. After looking at other alternative uses of the lake bottom shale-like covering Ataritiri, they concluded its best use might be as road fill.

They are now looking at the potential advantages of combining district heating and district cooling facilities. They are looking at servicing the railroad lands through DWLC, which would be about 10% of the total size of the DWLC market.

They have looked at the potential of ice-based systems which would share some of the advantages of DLWC, but which could only be used for smaller areas.

Werner Wickman of Toronto Public Works dealt with issues of possible impact on traffic, public works, underground utilities, etc. It will not be easy to accommodate another major utility because of existing underground congestion. Because of limits on above-ground public works, most of the work would have to be carried out by tunnelling. It would be possible to use new technologies, such as "micro-tunnelling". This will still require construction of chambers, shafts and staging areas, which would have to be done on weekends and evenings. It could be done with good planning.

He cautioned against using the storm sewers for the discharge water.

Discussion

Farrell Boyce of Environment Canada asked Ciccone about "looping" in the boundary layer, and the mixing of air. Ciccone was also asked by Danny Harvey if surface water wouldn't be cooled by DWLC.

Ciccone said they wanted to look at "worst cases" which might assume warming in the longer term.

Don Stevenson asked about the impact of combining district heating and cooling.

Honsberger said new areas could be serviced at the same time, thus providing for savings. Wickman said that the underground impact of installing district cooling would be similar to that of district heating. Bob Tamblyn showed a slide showing how pipes could be put in which

could accommodate both intake and discharge water pipes as well as smaller heating pipes.

Bob Honsberger was asked by Danny Harvey about the potential coverage of different chiller systems. He replied that the larger the system, the more efficient.

Michael Wiggin asked about using the fill for lakefill.

Michael Longman of MacViro said there are few chemical concerns about using shale bedrock for lakefill. He said the Leslie Street spit is now virtually complete and no other big projects are on the horizon. He said the Crombie Commission will likely caution, for ecological reasons, much use of lakefill in the future.

Danny Harvey then concluded Session C.

Session D - Economics, Financing, Proponency And Approvals

Norm Rubin introduced this panel. He said the panel would address the issues of whether it should go ahead, how, and what obstacles would have to be overcome.

Peter Burns said there are two separate initial funding issues - funding an environmental assessment, and funding the project. The environmental assessment money would be risky, because of the possibility of a negative or overly conditioned result. It would be easier to raise the over $600 million for the project, if it were the proposal of a consortium including Ontario Hydro.

He suggested that public sector money would probably have to be provided for the environmental assessment. Possible funders would include: Ontario Hydro, several provincial ministries, possibly EMR, Metro and the city of Toronto.

There would be a bigger range of members of a consortium to handle funding the project itself. There could be equity participation by a number of private and public bodies.

Ownership and operation could be the Toronto District Heating Corporation or many different possible consortia after the equity partners or consortium have recouped their investment.

He said there would be large opportunities for profit, particularly if buildings on the route of the pipes were required to hook in - as with water (ie, The Local Improvement Act).

He outlined a number of alternative methods of distributing possible profits from the system.

Jack Gibbons spoke to selected cost recovery issues. If it were to be self-sustaining, he suggested the costs could be covered totally from customers, or partially from customers. The project could be subsidized by beneficiaries or polluters. The beneficiaries could include Ontario Hydro, users or those who would benefit from higher quality air. If polluters were to pay, it would depend on the definition of polluter. It could be users of air conditioners, or electricity producers.

Possible ownership options could include municipal ownership (particularly if the profit potential were high), or a variety of public or private entities.

Rod Holme said Proctor and Redfern has worked on the cost of tunnelling and the capital infrastructure required. Among the components he looked at were:

- the size of the intake structure
- the tunnel
- the pumping station near the shoreline
- the supply tunnels up to Bloor Street
- surge protection
- return tunnels and pipes
- reuse of energy
- tunnelling techniques
- microtunneling (must be used because of underground congestion)

The cost elements have been based on careful interviews with experts. He said they would not change a great deal as a result of geographic rerouting.

Bruce McArthur, speaking on behalf of building managers and owners, said these would be the major customers of the system. Building owners have to buy cooling and are concerned about reducing energy requirements. He said energy requirements had dropped

considerably but recently had increased as a result of automation and communications developments.

He said operating costs for buildings in downtown Toronto were among the highest in North America. He said there is an international economic context just as there is an international environmental context. He is worried about references to "frontage fees" or other quasi-taxes. He said he thought the project should be self-sustaining, perhaps with the involvement of a public utility.

Denis Stevens of MacViro said he would talk about the environmental and other approvals that the project would have to go through. He said the Environmental Assessment Act was normally the toughest hurdle, with the biggest cost and time demands. The Act requires a plan of action. It is important for project proponents to know the main elements of it. In the Act, the environment covers almost everything, a much broader definition than in any other legislation. The Act covers public sector projects as soon as planning becomes specific, but only designated private projects. In almost any circumstance, DWLC would be covered by the Act.

He then went through the elements of an environmental assessment. He stressed the necessity of not only discussing the rationale for the project but also of alternative methods of reaching the same objectives. In addition, alternative methods of implementing the project and dealing with environmental impacts must be dealt with.

Stevens then discussed a strategy in dealing with the requirements of the Act. He set out in broad terms on slides the outlines of a proposal for DLWC to submit for an environmental assessment. In particular, he set out a series of headings or criteria to review alternative methods of achieving the DLWC goal, and to set out the specific environmental implications of the project.

Bob Tamblyn said the time for environmental approval would be the wild card in both the construction schedule and the cost. He set out a series of slides showing various time schedules and costs.

He took for detailed investigation a stretch of branch pipe between King and Wellington as an example of the specific issues that would arise in construction. On each point, he consulted engineering firms and other experts to obtain conservative costing. His overall estimate for the project including interest charges, would be $611 million for a project to be begun in 1992 and completed in 1999. He also built in a potential

Hydro subsidy of $135 million as a bonus for reducing electricity demand which would mean a net cost of $476 million.

He then compared the cost of DLWC to individual chillers for building owners. He set out figures for the period from 1999 to 2040 showing an annual cost by 2040 of almost $1.5 billion for chillers as opposed to $520 million for DLWC. The key is a rapid agreement by building owners to convert to DLWC from the outset. He said that in 1999 DLWC could probably deliver cooling at about the same cost (+- 22¢) as conventional chilling, but DLWC would be considerably cheaper as time went on.

He went through a whole series of problems that could upset his cost projections. He concluded that even if the cost of construction were to double, it will still pay off over the long term.

Discussion

The discussion period began by **Bruce MacOdrum** asking what the cost impacts would be of delay in construction or in getting people on stream and of the possible implication of water rentals.

Bob Tamblyn responded by saying he had calculated the cost of delays in people connecting. He said with a worst case scenario there would have to be some bridge financing between 1999 and 2010. He said the pipe construction would be spread among many construction companies which would reduce possibility of delay. He said he had been told that Lake Ontario water would be free but that there could be water rental charges in the future.

Burkhart Mausberg asked what other ways of reducing CO_2 could be contemplated with the $611 million. Peter Burns said that the money would likely only come through for an economically viable project... which DLWC appears to be.

Richard Gilbert asked several questions:

1. what are the alternative ways of dealing with CFCs?
2. how do large office towers compare in energy use with smaller buildings?
3. who should own and operate the system and why?

Bob Tamblyn said in response to the first question that if people bought chillers now they may have to get rid of them around 2015 when HCFCs are forbidden.

Bruce McArthur said cooling would still continue and technological advances would be made. Building owners would continue to look at competitive costs of cooling.

Bob Tamblyn said with regard to 2) that Ontario Hydro had been doing energy audits for years. New buildings are being designed for less energy use in terms of cost per square foot but have experienced increased energy use since. He doubts that smaller buildings are more energy efficient because there are economies of scale in cooling. Bruce MacArthur said larger buildings tended to be more energy efficient.

With regard to who should own and operate the system:

Bruce MacArthur said an agency like the Toronto District Heating Corporation would be logical. Building owners would want the freedom to go on or off the system.

Bob Tamblyn said he would like to see the construction done on a competitive basis by private companies and to have TDHC be the distributor.

Denis Stevens agreed by saying a non-profit agency like TDHC would make sense as the distributor and ultimate owner. There is a public responsibility so long-term costs and benefits should be public.

Norm Rubin said he agrees with Bob Tamblyn because of the horrible examples of overruns in public sector megaprojects like the Darlington nuclear plant.

Rod Holme supported the Tamblyn approach. From the point of view of an engineering contractor, it is important he deal with a single body that can make decisions quickly.

Jack Gibbons said if it were to be profitable, the municipal government would like to own it. The province would not have to own it to make profits. If it were to be privately owned, it would have to be regulated as a utility.

Peter Burns said he could see a public/private sector equity consortium which could hold together until initial equity and return was paid off. After that time, it would be logical for the TDHC to take it over.

Kevin Loughborough of Metro Public Works asked about differences in the prospective cost of the environmental assessment.

Denis Stevens said his estimate was based on other major projects but he was not aware of reasons for different estimates from the Ministry of the Environment. He said he thought DLWC should have less noxious and undesirable environmental and siting issues than many other mega projects. Therefore, he thinks $3 million and 3 years is not out of the ballpark.

Loughborough then asked if the intake tunnel should be duplicated in case of catastrophe, particularly if all of downtown were on it.

Tamblyn said the only danger to the intake tunnel would probably be a major earthquake. If there were such, the customers would also be sharply affected.

Franz Hartmann asked how the profitability of the project would be affected by a 75% reduction in the cooling load.

Tamblyn said if there were anything greater than a 40% reduction it might not be worthwhile for it to go ahead. He said this would only relate to the cooling issue.

Hartmann said this would mean there would be no incentive to decrease energy use more than 40%.

A participant congratulated the presenters and particularly Bob Tamblyn. He said other mega projects have succeeded. He referred to the Channel Tunnel where a consortium of banks and developers went ahead with it. He said there was great suspicion in the private sector about public sector mega projects which have often not come about, eg. - the PEI causeway, a Northern Ontario garbage disposal site, etc.

Dean Jordon of Ontario Hydro said Hydro is actively encouraging energy-saving projects. He said a $135 million Hydro incentive is out of any current range. He said Ontario Hydro would have to look carefully at risks and alternatives.

Norm Rubin said one could not assume any construction activity before approvals were obtained. He asked Peter Burns about the desirability of totally separating the environmental assessment from the project.

Peter Burns said the province has a fiscal problem that limits its capacity to bridge finance. He sees a way of pleasing everyone by splitting the two. He admitted that a viable option would be to have a regulated private utility.

Norm Rubin asked why Jack Gibbons had suggested that a private owner would not charge enough. Gibbons said if it were a very profitable system, it would have to be regulated. This could mean that everyone not located in the downtown core would want to be served by it - something that may not be in the interests of energy efficiency.

Richard Gilbert concluded the afternoon session by thanking ail panellists and participants.

Evening Session - Overview June 17, 1991

Introduction: **Aubrey Leblanc** introduced the evening session. He said the point of the session was to recap the day and then to discuss some of the more controversial issues raised during the day.

Richard Gilbert then gave a brief history of the proposal. He stressed that the Deep Water Cooling Investigation Group is not formally the proponent of the project but is an ad hoc group of organizations that have funded the investigations.

He said that the morning sessions had produced concerns from Pollution Probe and the Toronto Environmental Alliance. He paraphrased the TEA's opposition by saying it feared that going ahead with this project would deter action on other conservation measures. He also raised the issue that there might be a disincentive to proceed with energy efficiency measures if DLWC needed a fixed load to maintain viability.

Gilbert then went touched on with the issues raised in the morning. They included:

- inevitable surprises
- disturbing sediment
- dilution of pollution
- public health and other social effects not explored
- depletion of cold water reservoirs - "a renewable resource?"

- what if everyone does it?

- context may still be too narrow

- ore creative uses of fill or waste water

He said that Joan King's support from Metro would probably have been echoed by a representative of the City of Toronto.

The session on air and land was seen to be almost universally positive. More could have been said on the use of fill.

The final session raised many issues:

- environmental assessment process is a big variable

- ho might carry the ball?

- here seemed to be a consensus that the private sector should build and TDHC should operate

Discussion Franz Hartmann of the Toronto Environmental Alliance praised the quality of the background document and the proposal from Bob Tamblyn. He is very happy that it is a public consultation about energy efficiency. He has heard:

- from Greg Allen about the possibility of reducing office energy load by 75%

- from Bob Tamblyn that there is real reluctance to achieve this reduction

- that DLWC acts as a disincentive to increased energy efficiency above 40%

The proposal has 2 problems:

- it doesn't deal with causes

- it acts as a disincentive

What is our alternative?

- full-cost energy pricing

- tough standards for new buildings

- full retrofits

These would provide much greater energy reduction than DLWC.

Why not use DLWC as a pilot in a restricted area like the railway lands? Have a competition for alternative cooling methods. Let's continue but let's not undermine the achievement of our goals.

Danny Harvey said he wanted to comment on the relation between climatic change and the proposal. He said we are probably committed to a CO_2 doubling - which could lead to a 4-5 degree winter warming. This might reduce the 4° deep lake water reservoir. Therefore climatic change *could* undermine the effectiveness of DLWC - in 60 years or so. Therefore, make sure it's paid for by 2050! This adds urgency to the point that buildings connected to it should be as energy efficient as possible. DLWC *may* be the best way to reduce the cooling load. The options should be explored and incentives should be built into the proposal. He expressed concern about the Toronto Environmental Alliance position. He said that even though there were potentials to reduce energy use by up to 75%, nobody thinks that the actual reduction will even be close to that.

Richard Gilbert questioned his fear about the possible depletion of the 4° deep water reservoir. Harvey said that we were due for at least a doubling of CO_2.

Henry Regier said that in Lake Erie there is no 4° deep water. In response to Hartmann's point, he said it would be bad if DLWC were seen to be a gigantic technological fix - which might deter a more thorough approach to the source of problems.

He said that if it were to be seen around the Great Lakes as a glorified technological "fix", there might be an amendment to the Great Lakes Water Quality Agreement and a taking up of the proposal by other centres.

Greg Allen said he thought it is essential to have a massive reduction in energy requirements. He said the environmental community wanted to see more vision about the future. Forty years ago air conditioning was seen as a marvel. Forty years from now there should be much more liveable, less energy intense, cities. Therefore, he and Regier and others would like to see this studied further only in the context of a new vision.

Richard Gilbert said there were some paradoxes - large buildings are more energy saving in transit and heating and yet may not be in cooling.

Allen said that high density in the downtown core requires exploitation of the hinterland. More sustainable communities tend to be dispersed. Large buildings may be heat effective but they have other drawbacks like no natural ventilation. You can achieve energy self-sufficiency in a small community.

Gilbert said this didn't deal with the population growth and size of the Metro area.

Franz Hartmann said every bit of energy saving is vital and we should be a model for minimizing the greenhouse effect.

Gilbert said if DLWC will eliminate 100% of CFC's and other methods will only get up to a 75% reduction, why oppose DLWC?

Hartmann said you have to go to basic causes first.

Leblanc said you then require regulations and pricing to change habits. **John McMillan** of the Office of the Greater Toronto Area said cities are dynamic and growing entities. People working in buildings want to work in a cool environment. He wonders if its success requires everyone signing on the DLWC system to make it work. McMillan wondered if a solution to a cooling problem in downtown Toronto in 1990 will solve problems for the whole GTA in 2000.

Leblanc responded by raising the timing question. All major infrastructure projects have to be committed well in advance. Here there are two things in different time sequence. Some behavioural activities could be changed faster by regulation or pricing. Something like DLWC requires a certain degree of faith - and a faith that things will happen in parallel. Surely it is possible to have DLWC at the same time as a whole series of conservation actions.

Michael Wiggin said he will be going later in the week to a conference on district energy systems. The Brundtland report spoke about district systems and co-generation, which would include district cooling. In Malmo, Sweden there are areas where different strategies are used. He sees no problem in moving in the densest area now and spreading it further later.

Hartmann said he hopes that in 10 to 15 years DLWC will be unnecessary. He is not optimistic about the compatibility of DLWC and other energy conservation measures. He is sure that it would result in a reduction in motivation of decision-makers in all sectors. He suggests

that we wait 5 years to see how other energy efficiency measures have worked.

Richard Gilbert said this is a salutary caution. He said you must always move on several fronts in the environmental area. He cited the improved fuel efficiency of cars of the early 80's without raising gasoline prices - which just meant that more people bought cars. He also used the blue box example: with parallel reduction efforts it might even be counterproductive. He said he was not totally committed to DLWC but he rejects a strategy that rejects a good thing just because it might deter other actions.

Hartmann said there is huge resistance to move beyond recycling to reduction and reuse. He always wants to go to the root of an issue. Source reduction is the key. He said DLWC will be like a blue box solution.

Henry Regier said there is an infectious enthusiasm that goes with big projects - which all have their downsides. Wild-eyed engineers have a tendency to lead the people of Hamelin.

Bob Tamblyn said he hoped we would get the momentum to kick this project off. He reviewed the results of energy audits in buildings around Toronto and repeated his arguments that large energy savings will not occur.

Don Stevenson suggested there should be more of a parallel discussion of the experience with Toronto district heating.

William Chakeris of Toronto Hydro replied that district heating had some dangers - but it has worked. The aim was to use expert methods, high stacks and best fuels - first it was steam - now it is gas. There was no return system so you had to keep the system going winter and summer. Some European district heating systems have been world leaders in environmental protection.

Michael Wiggin said district energy systems can change with the times. They can minimize environmental impact and maximize efficiency. District cooling is virtually the same thing. It could be adaptable to other sources of "cooling". What we would do is to generate an infrastructure for delivering cooling around the city.

Jack Gibbons asked about Tamblyn's assumptions about energy price increases. Tamblyn said 5% a year - the same as overall price increases.

Norm Rubin reminisced about the district heating experience. He said we are now more enthusiastic about co- generation.

Conclusion Aubrey Leblanc closed the session by inviting people again to attend the charrette. He expressed his thanks to the CUI, to the participants, researchers and panelists. He said the original investigation group has been expanded by the participants of the last two days. He invited all participants to join the investigative group on July 25.

He commented on some of his own perceptions of the discussion, including:

- the potential to make DLWC even bigger
- more possibilities for returning water
- more possibilities for using excavated fill
- possible ways of using potential surplus revenues to meet some of the criticisms of the proposal
- need to go beyond the technological "fix" - no one thinks it can be done alone
- DLWC can be a catalyst for a whole range of energy-conservation measures
- more discussion needed of economic impacts - possibility of consortia
- other things are happening anyway: - intensification is the key to other measures by provincial/municipal governments
- cabinet has approved an off- electrical strategy - no more baseboard heating in social housing
- he has been asked to ban electric heating which may require higher electricity prices
- argon or double-paned windows
- new standards for existing buildings
- Michael Nixon in charge of building in Toronto is also a strong proponent of such measures

- the province is also changing plumbing standards
- promotion of transit, preservation of green space and more compact residential development
- there is a desire to integrate heating and cooling systems (a third pipe could be added to the DLWC system for the heating)
- there will be changes in electricity pricing policy

With regard to the DLWC concept:

- much of the debate is about time
- time is money for big projects
- we may be missing a window of opportunity
- he would argue in favour of parallelism with other energy conservation measures
- would like to work with environmental and other groups
- wants to have a thorough environmental review
- always a potential that other regulations and measures won't happen

He closed by inviting participants to come to the charrette tomorrow.

4 REPORTS BY THE CHARRETTE TEAMS AND TEAM MEMBERS

Group A, led by Danny Harvey, University of Toronto

Question 1 Is there adequate supportive evidence and interest to suggest that consideration of DLWC should continue?

Response Nine out of ten members of our group felt that consideration of DLWC should continue, although not without certain conditions. The conditions required, and the rationale of the lone dissenter, are indicated below. The scope and goals of the DLWC proposal are not yet clear. For example, is it merely a proposal for a renewable energy supply - a technical fix - or is it a proposal which forms part of a larger strategy to reduce energy consumption and peak power demand? If the latter, is it possible to mandate energy efficiency improvements within the context of what is essentially a renewable energy supply proposal? Is the purpose of the DLWC proposal merely to provide economical cooling to buildings in the downtown core, or are CO_2 and CFC emission reduction important or even primary objectives behind the DLWC proposal?

Question 2: For Those Supporting Further Consideration What issues and alternatives should be considered during an approval process for DLWC under the Environmental Assessment Act and other legislation?

Response The group identified the following issues and questions for further consideration:

1. Impacts on Lake Ontario

To date only impacts on various physical parameters, such as temperature and nutrient concentrations, have been identified. The impact assessment must be carried further to involve an assessment of impacts on life forms and the aquatic ecosystem, and their significance. Impacts arising from both the water intake and outlet need to be determined.

Impacts should be assessed in the context of climatic change, natural variability, and remedial action plans, both at the local and lake-basin scale.

An accurate determination of the change in net heat input to the lake and its significance is needed, accounting for direct heat input, avoided thermal power plant input, and reduced heating of the lake through a reduced urban heat island.

A more complete assessment is also needed of the impact of discharging the cooling water into the Don River and of any other potential discharge sites.

2. Compulsory Contribution to Capital Cost?

The problem of financing the upfront costs of DLWC could be handled in the same way in which new water and sewer services in an existing development are financed - namely, all property owners are required to pay local improvement charges. Generally, the owners are polled first to see if a majority are in favour of the new service, and if so, all owners are required to contribute.

In addition to the compulsory capital charge, there would be expenses for hooking up to individual buildings. One possibility would be for Ontario Hydro to pay the hook-up costs if certain energy conservation performance standards are met, as the hook-up costs alone are comparable to the avoided costs that Ontario Hydro is prepared to pay under its current rules. An alternative scenario might be for Ontario Hydro to assume 100% of the upfront capital costs and then recover its costs plus a rate of return

3. Energy Efficiency

The DLWC undertaking should be defined in such a way as to combine the two objectives of renewable cooling and energy efficiency. There are several ways in which this could be done. However, the first requirement is a comprehensive assessment, not of the technical energy efficiency potential, but of the economically justifiable (from a total

societal point of view) degree of cooling energy reduction that could be realistically achieved.

Decisions on the capacity of the DLWC system, and economic calculations, should assume that the above-mentioned degree of cooling load reduction is achieved. Calculations should not be based on the assumption that the current building energy intensity continues into the future. That is, engineering and economic calculations for DLWC should assume an aggressive program of energy efficiency improvement and reduction in heating and cooling loads for new and existing buildings in the Province of Ontario, with due account taken of uncertainties.

One way to build an incentive for efficiency improvements prior to hook-up would be to make the capital levy proportional to the building's cooling needs, analogous to proposed hook-up fees for electricity. Another mechanism, identified above, is for Ontario Hydro to pay the hook-up fee if minimum energy performance standards are met.

4. To what extent can absorption cooling be used as an alternative to, or something which could complement, DLWC?

The group identified the following absorption cooling-based alternatives or complements to DLWC, all of which would eliminate use of CFC's and greatly reduce CO_2 emissions. All of these options could involve absorption chillers in individual buildings, or centralized absorption chillers if economical.

a. Solar. Solar absorption chillers are not yet cost effective, but are very close to being cost effective in new buildings with state-of-the-art energy efficiency measures. The solar panels used for cooling purposes in summer could be used for space heating in winter, thereby improving the economic viability of the system. Solar absorption chillers are unlikely to be suitable for tall skinny buildings, since a rule of thumb is that the solar panel area should be about equal to the window area. Where solar absorption is used, there is a possibility of forming a hybrid with other heat sources as back up.

b. Steam from the Toronto District Heating Corporation (TDHC). This would provide TDHC with a summer load, which is highly desirable from their point of view.

c. Natural Gas with brine refrigerant. This option would be considerably more efficient than electricity from coal, and is close to competitive with electric chillers at current electricity rates.

d. Heat from Cogeneration. TDHC could be extended to include cogeneration of electricity along with heat production. Use of waste heat from cogeneration would be much more viable using a hot water rather than a steam system. The existing TDHC steam pipes could be converted to a hot water pipe but requires a return warm water pipe, which could be economically installed when the DLWC pipes are installed. The net result would be a combined heating, cooling, cogeneration system.

The group identified a number of other issues that need to be carefully considered in implementing DLWC, absorption cooling alternatives, or some combination of the two. For example, under some circumstances, use of DLWC could increase energy requirements in a building. If the mechanical, heating, and cooling systems are already integrated (ie.: heat pump), the building owner could be purchasing additional energy with the DLWC system. A building in winter where interior zones need to be cooled can reject the excess to periphery. With DLWC the heat is not rejected within the building or is of lower quality (ie.: mechanical chillers reject heat at 70 C, not 13-14 C). The good mechanical design in such buildings would in effect be penalized if they were required to pay a capital charge. There will still be net benefit of DLWC in such buildings, however.

Question 3: For Those Supporting Further Consideration

Who should own and operate a DLWC system?

Response

There are a number of important considerations with regard to ownership and operation. The cooling resource is part of the social commons. It may therefore be more acceptable to have public rather than private management of this resource up to and including the first pumping station. Ownership and operation of the distribution system could lend itself to either public or private structures, and there are advantages and disadvantages to both options. However, both could be made to operate in the public interest. A reconstituted TDHC could take advantage of the prevailing good will of its downtown customers, who are potential cooling customers. Opportunities exist for multiple use of at least parts of the system. For example, the intake pipe and the first pump station

could be used to supply potable water as well as cooling water. That portion might therefore be owned by Metro.

Public financing of the supply system should be feasible based on the existing powers of the Province and Municipalities.

Question 2: For Those not Supporting Further Consideration (i.e., one member of the group)

If not, why not?

Response

Critical environmental groups do not support the project for strategic reasons. Their support is needed for a meaningful, thorough, and timely hearing. There have been about 18 hearings since the Environmental Assessment Act was enacted in 1977, and have cost approximately 25% of project cost on average. This cost could be dramatically reduced if prior support from environmental groups is obtained. Environmental groups opposing DLWC for strategic reasons should be accountable for precluding the further consideration of the DLWC project. Securing a proponent/sponsor of the undertaking is made more difficult by the lack of support from key environmental groups.

Question 3: For Those Not Supporting Further Consideration

Do you support any alternatives?

Response

The same set of alternatives identified above is applicable here.

Group B, led by Norm Rubin, Energy Probe

Question 1

Is there adequate supportive evidence and interest to suggest that consideration of DLWC should continue?

Yes, subject to the need for review of issues and alternatives in the ``pre-prononency'' phase, before preparation for EAA hearings:

Is there a price (and a set of terms) for DLWC at which the market of potential users will commit itself (e.g., via Local Improvement

provisions)? Is there an alternative acceptable arrangement for "consensual" mandatory uptake by potential users?

What is the potential for cost-effective reduction of cooling load (and CO-2 emissions, CFC emissions, total electricity consumption, total energy consumption) in the area to be served by DLWC? At current electricity and chilling costs? Using the same economic assumptions as used in DLWC? What impact does that reduction have on the viability of DLWC? What impact does (or can) DLWC have on the likelihood of realizing those reductions? Can this exercise be used to promote solutions and "partnerships" outside the technical and geographical range of DLWC?

What are the sensitivities of the viability of the project to increased (or decreased) geographical range; additional uses for input and/or return water.

Are there technical alternatives to DLWC (and to today's heat production by the Toronto District Heating Corporation) that are economically and environmentally preferable to DLWC, e.g., cogeneration for district heating and absorption cooling (new central or distributed, or Hearn station re-start); turbine-driven pumps/chillers with absorption cooling from waste heat; solar absorption chillers, especially for new buildings; ice-slurry district cooling.

Name: if the scope of this discussion is expanded to include alternative improved cooling (and heating) technologies, the name of the Investigation Group should reflect that scope.

Proponency issues:

Should ownership of DLWC and TDHC be combined, and in which direction?

Can potential (private-sector) owners-proponents be polled to determine the questions they need answered before becoming actual owners-proponents?

Can those questions be answered adequately at this stage to induce those private parties to become owners-proponents?

Question 2. What issues and alternatives should be considered during an approval process for DLWC under the Environmental Assessment Act and other legislation?

Issues and alternatives to be considered during [EAA] approvals:

In addition to the aforementioned and the environmental and social impacts referred to in reports from EIL, MacViro, and Pollution Probe:

What is the range of appropriate and realistic "null alternatives" to this Undertaking? I.e., what could building owners and operators be expected to do over time in the absence of DLWC?

Question: Who Should Own and Operate a DLWC System?

If the uncertainties in the user market can be resolved (as discussed above), can the remaining uncertainties be made manageable enough for a private-sector developer to commit to DLWC before EAA review? If not, is a meaningful EAA review possible if the ultimate developer is not the "proponent" in the EAA hearing?

Our group greatly prefers private development and ownership of DLWC, or alternatively of the bulk cool-water portion of the system, with TDHC or another public entity distributing the cool water to end-use customers, to all other ownership arrangements. We see the need for further discussion of our two preferred alternatives.

Our opinions on taxpayer subsidies varied, ranging from those of us who were inalterably opposed to those who wanted pre-conditions for public subsidies clearly spelled out in advance.

Separate Report made by a member of Group B, representing the Toronto Environmental Alliance (TEA):

The Toronto Environmental Alliance (TEA) would first of all like to thank the conference organizers and contributors for the opportunity to participate in this important and necessary investigation. Moreover, we would like commend the conference participants. What has emerged over the last few days is a thoughtful and provocative discussion of the possible strategies towards reducing CO_2 production and CFC use. Essentially, what we are discussing is how to avoid a most catastrophic environmental problem: global warming.

The Toronto Environmental Alliance came into this conference strongly opposing the DLWC Proposal as set out in the background prepared for the conference. While the idea of Deep Lake Water Cooling has potential, we feel this application of DLWC will ultimately further add to the greenhouse effect. Our reasons are simple and straight forward.

1. This proposal does not address the major causes of CO_2 production and CFC use --subsidized electricity rates, highly inefficient electrical equipment, and bad building design. All it does is address the symptoms of the problem: how to most efficiently **cool** buildings that are essentially energy vampires.

2. This proposal will probably impede serious consideration of addressing energy conservation issues. Given its **alleged** benign environmental impact, going ahead with the DLWC Proposal will make it that much easier for builders, owners, tenants and other electricity consumers to resist conservation strategies while giving the appearance that something is being done.

Our criticisms of the Proposal at the beginning of the Conference have, if anything, been reinforced by what has been said in the last few days. For example, a supporter of the Proposal essentially stated that there is already much reluctance by office owners, tenants, and other electricity consumers towards meaningful energy conservation strategies. Based on this assessment, TEA believes that the DLWC Proposal will give people the opportunity to appear **green**, meaning there will be even less incentive to mowe towards energy efficiency.

It was also revealed by a supporter of the proposal that the financial viability of the project would be seriously compromised if conservation strategies reduced the cooling requirements of buildings by 40% or more. In other words, this proposal has an inherent financial disincentive towards meeting substantial energy conservation. These two facts alone lead us to conclude the Proposal has serious problems.

What has also emerged from this conference and what TEA believes are the most significant facts are that:

1. it appears that cooling demands can be significantly lowered, possibly by up to 75% (see Greg Allen's background paper prepared for the conference);

2. Significant energy efficiency gains can be made by utilizing more energy efficient office equipment, lighting building retrofits and new building designs;

3. Many possible cooling alternatives exist (see Greg Allen's paper) that may make the DLWC proposal unfeasible once energy efficiency gains are made.

In other words, if we concentrated on energy efficiency gains and cooling reduction, **major** reductions in CO_2 emissions and CFC use could be made, thus better fulfilling the laudable goals of the DLWC proposal.

The reason for this minority report is based on the reluctance of other members of the discussion group to seriously consider energy reduction strategies. The group was asked to endorse the following alternative to proceeding with the DLWC Proposal:

1. A commitment to an investigation of energy efficiency options that is—at minimum—equal to that given so far to the DLWC proposal. The investigation would have the following aims:

    a. identifying options for the implementation of full-cost energy pricing;

    b. identifying methods and determining levels for strict energy efficiency standards for all energy-consuming equipment in the City of Toronto;

    c. a time-tabled retrofitting of Toronto's buildings with energy efficient office equipment and lighting;

    d. alternative methods for implementing environmentally sound and energy efficient building standards for existing and new office buildings.

2. While this investigation is proceeding, the DLWC Proposal should be put on the shelf. It would be foolish to proceed with a $700 million (in 1999 dollars) megaproject that may be deemed unnecessary depending on the outcome of the above investigation. Taxpayers should not be burdened with the cost of further investigating a proposal that may be unnecessary.

3. When the investigation is complete, it will become apparent what levels of energy conservation can be met. With this information, it will then be possible to predict the cooling needs of the City's downtown. An investigation should then be made into the most appropriate cooling option(s) for the City. The DLWC option should then be explored.

This energy reduction strategy was opposed by the other members of Group B. Their opposition was based on the belief that the above concerns can be addressed while proceeding with the DLWC proposal.

TEA strongly disagrees with this assessment, based on the inherent disincentives towards energy conservation in the proposal as identified above.

TEA believes the goal of this conference should have been that of finding the most feasible and comprehensive means of CO_2 and CFC reduction. Apparently, this is not the goal of others participants in the conference. The support for the $700 million mega-proposal (described by some as a high-tech fix) suggests the real goal is getting the DLWC mega-proposal through at all costs, regardless of its need and regardless of its potential undermining of real energy efficiency gains.

Group C, led by Henry Regier, University of Toronto

Question 1. Is there adequate supportive evidence and interest to suggest that consideration of DLWC should continue?

Qualified yes. There is enough supportive evidence and interest to consider further the concept of DLWC.

However, the context of this consideration is important. It should not be forgotten that the overall objective of this and other measures is the sharp reduction in energy consumption with its concomitant pollution (CO_2, CFC's, heat....).

DLWC should not be considered in the absence of firm, formal, political commitment to the strategies of:

1. Full cost pricing of energy;
2. Energy efficiency measures;
3. Improved building standards; and others.

Emphatically DLWC is not to be considered as a substitute for action on these strategies.

Bob Tamblyn, Energy Interface, wished to record his view that large reductions in the cooling demand of existing buildings are unlikely, lending increased urgency to DLWC.

Mausberg, Pollution Probe, urged that action on DLWC should not take place until significant action had occurred towards the three strategies listed above.

We agree that a "full" assessment (including environmental, social and human health considerations) is necessary but we are not clear about the form of the assessment.

For example, in view of Lake Ontario's international status and interest in the United States in similar DLWC schemes, the International Joint Commission Reference process may be appropriate. Or it may be that an approval process under the Ontario Environmental Assessment Act may be adequate.

Whatever route is chosen, we recommend full assessment in two steps:

1. Initial multi-shareholder negotiative process followed by;

2. Public Board or Commission hearing and subsequent decision on any strongly controversial issues.

Question 2 What issues and alternatives should be considered during an approval process for DLWC under the Environmental Assessment Act and other legislation?

The technical aspects of the EA process do not pose insurmountable obstacles. We know how to approach these problems with respect to environmental, social, and human health issues.

We should dedicate the use of high quality return water to high quality restorative measures. We should be careful to avoid remobilization of buried contaminants.

Question 3 Who should own and operate a DLWC system?

We imagined the implementation of DLWC according to the following guidelines:

1. Toronto District Heating Corporation manages distribution, sales, etc.,

2. A public consortium acts as the proponent through the EA process, bearing the costs thereof;

3. A private entrepreneur, following competitive bid, would build the facility, lease it from the owner (see below) and wholesale the water to the TDHC. Terms and conditions would be structured to encourage private raising of capital and payback with profit during the 20 to 30-year lease;

4. The City of Toronto is owner of the facility throughout.

Separate Report made by a member of Group C, representing Pollution Probe

Pollution Probe would like to thank the conference organizers and contributors for the opportunity to participate in this important and necessary investigation. What has emerged over the last few days is a thoughtful and provocative discussion of the possible strategies towards reducing CO_2 production and CFC use. Essentially, what we are discussing is how to avoid a most catastrophic environmental problem: global warming.

Pollution Probe came into this conference opposing the current DLWC proposal. While the idea of DLWC has potential, the current proposal is a technological band-aid; it does not address the problem at the source:

1. The current proposal does not address the major causes of CO_2 production -- subsidized electricity rates, inefficient electrical equipment, and unsustainable building design.

2. The current proposal could impede serious consideration of addressing energy conservation issues. Going ahead with the DLWC Proposal will make it much easier for builders, owners, tenants and other electricity consumers to resist conservation strategies while giving the appearance that something is being done.

The financial viability of the project would be seriously compromised if conservation strategies reduced the cooling requirements of buildings by 40% or more. In other words, the current proposal has an inherent financial disincentive towards meeting substantial energy conservation.

What has emerged from this conference and what Pollution Probe believes are the most significant facts are:

1. it appears that cooling demands can be significantly lowered, possibly by up to 75% (see the background paper prepared for the conference by Greg Allen);

2. significant energy efficiency gains can be made by utilizing more energy efficient office equipment, lighting building retrofits and improved building designs;

3. many possible cooling alternatives exist (see Greg Allen's paper) that may make the DLWC Proposal unfeasible once energy efficiency gains are made.

In other words, if we concentrated on energy efficiency gains and cooling reduction, **major** reductions in CO_2 emissions could be made, thus better fulfilling the laudable goals of the DLWC Proposal.

Therefore, Pollution Probe proposes the following procedure:

1. A commitment to an investigation of energy efficiency options, with the following aims:

    a. identifying options for the implementation of full-cost electricity pricing;

    b. identifying methods and determining levels for strict energy efficiency measures for all energy-consuming equipment in the City of Toronto;

    c. a time-tabled retrofitting of the City buildings with energy efficient office equipment and lighting;

    d. alternative methods for implementing environmentally sound and energy efficient building standards for existing and new office buildings.

While this investigation is proceeding, the DLWC Proposal should be put on hold. Proceeding with a $700 million proposal, which may be unnecessary at the proposed scale, seems to be a waste of money.

2. When the investigation is complete, it will become apparent what levels of energy conservation can be met. With this information, it will then be possible to predict the cooling needs for the City's Downtown. An investigation should then be made into the most appropriate cooling option(s) for the City, including the DLWC option.

Pollution Probe believes that the solution to reducing CO_2 emissions lies in source reduction: identifying the sources of CO_2 and attempting to reduce them at the source. Only once all source reduction options have been explored and implemented, should any consideration be made to the DLWC option.

5 CONCLUDING REMARKS

This section first sets out the points of substantial agreement among the participants in the conference and charrette. They concern firstly the potential impacts of Deep Lake Water Cooling (DLWC) on the *local* environment and secondly the way DLWC should be managed, if it is to proceed. Then the major point of disagreement is outlined; it concerns the overall impact of DLWC on the *global* environment. Finally, the section provides a preliminary assessment of the challenge facing the Canadian Urban Institute, which has been charged with advising the DLWC Investigation Group as to what, if anything, to do next.

A. Points of agreement: local environment

Throughout the process described in Section 1 above, the Canadian Urban Institute has tried to keep as open a collective mind as possible as to the potential advantages and disadvantages of implementing DLWC. We have intervened only when necessary to expand debate or sustain discussion. Nevertheless, we developed the view, shared with others, that the global environmental impacts of DLWC would be mostly construed as positive. If DLWC were not to proceed this would happen on account of insuperable concerns about its impact on the local environment or on account of analyses that showed DLWC to be economically unfeasible.

As it happened, the conference and charrette were mostly taken up with discussion about the indirect *global* impacts of implementing DLWC. The disagreement about these impacts is characterized in Part C of this section below. Concern about local environmental effects was given less attention - even though much more of the background work for the conference concerned local rather than global impacts.

The relative lack of controversy about local impacts at the conference and the charrette may have been simply the result of their being overshadowed by the discussion of global concerns. We believe the relative lack of discussion also reflected a measure of agreement that *if* DLWC is to proceed there should be a full environmental assessment

that provided the most profound scrutiny of every possible effect, particularly on Lake Ontario and its life forms.

Concerns about effects on the air were few; indeed there was general agreement that DLWC would lead to improvements in local air quality and climate. Concerns about the land centred mostly around the disposal of the excavate from the tunnel beneath the lake bed, which might have a positive or a negative impact.

There were numerous concerns about the Lake. These are set out very clearly and comprehensively in the previous section, which comprises the reports of the charrette teams and some members.

B. Points of agreement: management

There was general agreement that the management of DLWC, if it is to proceed, might be considered in four phases: pre-proponency, proponency, construction, and operation. There was also general agreement that an existing or new public-sector agency (or agencies) should have ownership and carriage of DLWC. Roles for the private sector were seen in both the construction and the operation of DLWC. There was particular interest in an approach that would have the basic DLWC system funded, constructed, and operated by a private entrepreneur who would lease the facility for a fixed period (say 30 years), repaying the debt and making a profit from the sale of cold water at a regulated rate to a public distribution utility.

There seems to be little doubt that, with the anticipated demand for cooling, DLWC can be financially feasible. Indeed much of the discussion of this point concerned how exorbitant profit-making from a public resource might be avoided. However, an unresolved matter – relevant to the controversy discussed in Part C – is the extent to which the economic feasibility of the project would suffer with reduced demand for cooling.

C. Point of disagreement: global environment

Two representatives of environmental groups argued against implementing DLWC at this time. They wrote separate reports that appear in the previous section. They argued that ``going ahead with DLWC will make it easier for builders, owners, tenants, and other electricity consumers to resist conservation strategies while giving the

appearance something is being done." Instead, they proposed concentration on improving energy efficiency and on thereby reducing the need for cooling.

The concern for improved energy efficiency was embraced by most of the participants in the process - indeed, many of them noted they had been in the business of securing reductions in energy use for several decades. The question came down to whether there was an early need both for DLWC *and* for a massive effort to reduce use of electricity in other ways as well, or whether further consideration of DLWC should be postponed until all other methods of reducing electricity use had been explored and implemented.

The challenge that the Canadian Urban Institute faces is that of providing the DLWC Investigation Group with a method for resolution of this question in one way or the other.

LIST OF CONFERENCE AND CHARRETTE PARTICIPANTS

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